

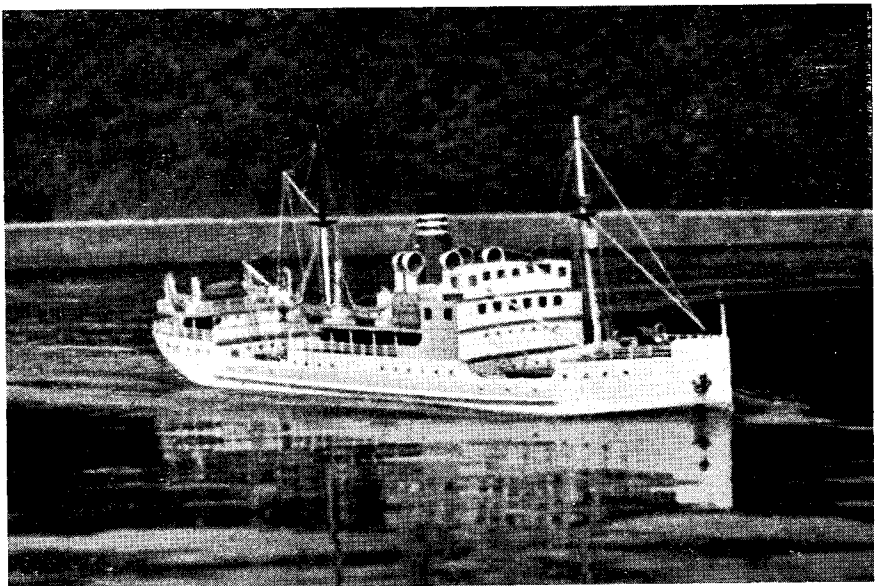
Methylated Spirit Firing

# THE MODEL ENGINEER

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A pre-war pleasure cruise in the Norwegian Fiords on a cargo passenger steamer? No!  
Mr. V. B. Harrison's 30-in. model on its home waters.

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Vol. 87 No. 2154

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August 20th, 1942

## Smoke Rings

### Model Locomotives as Holiday Magnets

NEWS continues to reach me as to the attractions of the model locomotive as a feature in "holidays-at-home" programmes. At Bexley, for example, Mr. R. C. Hammett has installed a fine 9½-in. gauge locomotive and track in Danson Park, which has given unbounded delight to the youth of the neighbourhood. The railway was officially inaugurated by the Mayor of Bexley, Councillor J. T. H. Ashmore, J.P., who drove the first train, his passengers consisting of a party of local Councillors and officials. Subsequently the line was open to the public and was besieged by children so long as daylight lasted. I also hear that the "Aylesbury Gang" at Luton have been busily engaged on a similar undertaking, and that the members of the Kent Society have been doing good work at local recreation grounds with their locomotives and portable track.

### Manchester Lags Behind

MY recent reference to power-boating in Manchester as an attraction for the "holidays-at-home" weeks, although based on information from a reliable local source, seems to have been due to a misunderstanding. The Hon. Secretary of the Altrincham Model Power Boat Club, the only club of its kind in the district, now writes me that he has been in touch with the City of Manchester Parks Department, who inform him that no such arrangements have been made, nor does that Department allow the use of the yachting ponds in the Manchester Parks for the sailing of model power-boats. The City Fathers of Manchester seem to be asleep. They have not awakened to the fact that in more progressive centres model power-boating has proved to be not only an outstanding attraction to the general public, but a direct stimulus to the mechanical genius of its adherents and of the younger generation. They also do not appear to realise that many power-boat men are doing splendid national service in their home workshops or in the munition factories, and deserve every encouragement to pursue their

hobby in suitable and convenient surroundings. It is strange that a city which has been the cradle of so much mechanical genius in days gone by, should now expose the clever technical experimentalists of the power-boat world to such a chilly rebuff. I wonder what Sir Joseph Whitworth, to whose achievements Manchester owes so much, would have thought about it.

### Overseas Visitors

AMONG the many representatives of the American Forces now in this country there must be quite a sprinkling of model engineering enthusiasts who would be glad to make contact with fellow devotees on the home front. I understand that the London Society has already extended a cordial welcome to overseas visitors who may care to attend their meetings or inspect their workshop, and I imagine that all the provincial clubs will open their doors in a similar warm-hearted way. If any American or other visitors from abroad are interested in making model engineering contacts, I shall be pleased to put them into touch with clubs or individual readers wherever possible.

### Model Engineers in the Far East

I HEAR that Mr. Tom Lawson, the President of the Nottingham Society, is now filling an important engineering job in the Services, somewhere in Iraq. Major R. O. Porter, well-known to London power-boat men, is also on duty in the same spot, and I have no doubt they will hold a local meeting. He sends his kind regards to all his friends and says he would rather be beside the lake in Victoria Park than "blastering in the blistered desert." Mr. Lawson, as industrious as ever, finds a few spare hours to be busy on building a 3½-in. gauge 2-10-0 goods locomotive, a much-used local type, and has persuaded another "M.E." reader, who works beside him, to build an "Iranian Garratt."

*Percival Marshall*

# Methylated Spirit Firing

## as applied to Model Steamers

By VICTOR B. HARRISON

FROM time to time I have received letters through *THE MODEL ENGINEER* asking my advice about methylated spirit firing as applied to model steamers, and also asking if there are any advantages as compared with the blow-lamp method.

I can fully appreciate the reasons for these questions, when it is well known that most of the model power craft of the many clubs in this country are fired by blow-lamp, using the central-flue type of boiler. There is no getting away from the fact that this method has much in its favour. Firstly, the boiler can be placed very low in the hull, as also the lamp. The flame of the blow-lamp is all inside the boiler, with the exception of the burner, which is outside and generally becomes a dull red heat when working. This, to my mind, is one of the disadvantages of this method of firing, as the heat from the burner is radiated in the hull. In large boats this probably does not matter, but in small craft it has been admitted that it necessitated the careful insulating of the adjacent parts of the hull with asbestos sheeting. The blow-lamp gives a very fierce flame for its size, and, further, the fuel, whether paraffin or petrol, when compared with methylated spirit, quantity for quantity, lasts longer and therefore a longer voyage can be made.

### Blowlamp Troubles

I may be a Jonah as regards the blow-lamp method of firing, but time and again at various displays I have seen blow-lamps give trouble. Also, if there is a wind about, they are the very devil to get going unless it is possible to get them started in the ship. I, myself, have experienced these troubles and others in addition. A choked jet is most exasperating, and generally happens when the ship is on the point of starting or in the middle of the pond. When the latter happens, it generally means a long wait before the model drifts ashore. Also, when the fuel gets low in the container the feed becomes erratic, and if the lamp goes out the hull gets filled with paraffin or petrol vapour. On cooling, the bilges contain liquid fuel. If petrol is used, great care has to be taken to get rid of all traces of it, for if not, a first-class fire will be the result. It was because of this unpleasant danger and also a friendly challenge issued to me by

Mr. Bassett-Lowke that I started experiments with methylated spirit. During a lunch we were discussing model steamers and he informed me that his experience was that, except in large sizes, they were not a success, and, further, in the smaller sizes so much ventilation had to be provided that they looked anything but the real thing. I argued that I felt convinced that a decent small model steamer could be constructed to look like the prototype and yet work well and reliably. In fact, I went on to say I was confident that a model with exhibition finish could be made to work by steam. To cut a long story short, he challenged me to produce one. Also, if I did, we might do a little business.

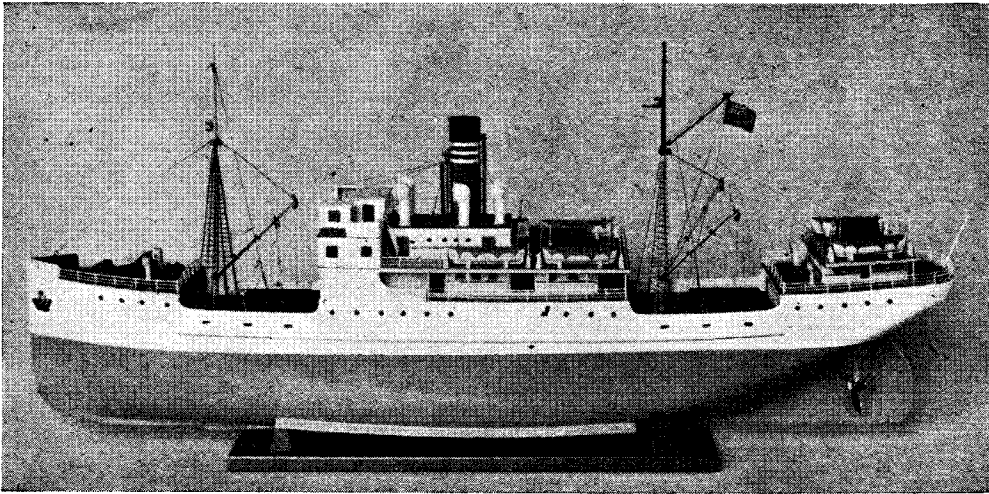
### Deeds Count

I took up the challenge, fully realising that it was deeds not words or plans now. I decided that I had better get to work on a small ship, because if my ideas proved successful in a small vessel, success would be assured in the larger sizes. It would be boring to relate all my trials and troubles, but I will mention one, for which I found the remedy.

I built two ships identically the same. They were 18 in. long and were free-lance designs of a coastal cargo boat. For the tests the decks were finished off and the funnels painted.

The boiler and the firing were a complete success. My experiments were many and at one time I felt I was going to fail. The little ship ran splendidly for twenty-five minutes each time, but, unfortunately, the decks were always distorted by warping. This puzzled me for a long time, as there was no damage to the paint work, either on the decks or the funnel casing. The funnel casing was cool to the touch, as were also the decks.

The decks resumed their normal shape after 24 hours. I screwed bearers underneath in an attempt to prevent this warping, but they did not make a scrap of difference. I began to think that Bassett-Lowke was right and I would have to confess defeat. The only remedy seemed to be "more ventilation." This would, naturally, spoil the external appearance and it would no longer be a show-case model. I decided, therefore, in a last attempt, to find a cause



The completed ship.

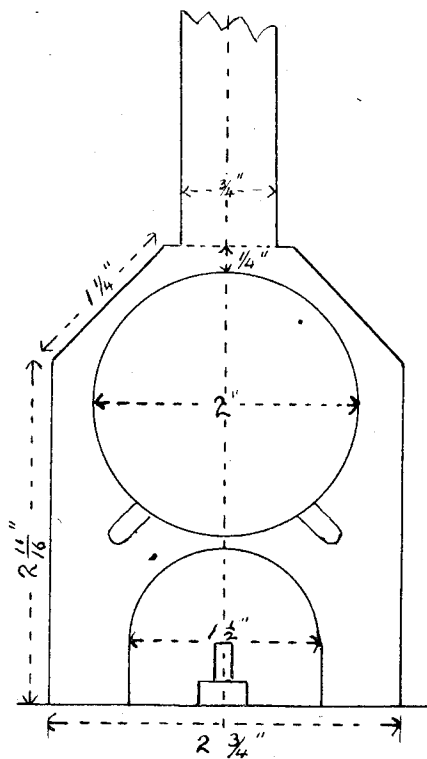
for this warping, by whipping off the decks directly the little ship had completed a trip. On removing the first portion of the fixed deck I discovered the cause. They were covered with moisture and as I had not painted the underside they were thoroughly wet and slightly warm. This moisture, combined with the heat, was undoubtedly the cause of the trouble. When they were thoroughly dry I gave them three coats of enamel. As soon as the paint was dry I replaced the decks and once again got up steam.

Imagine my delight, after the next voyage nothing had budged. To make doubly sure, I immediately got up steam again and off, when the little ship ran for another twenty-five minutes. I was very thrilled when still there were no signs of warping, as I had achieved success. As soon as I had completed all the deck fittings, etc., I invited Mr. Bassett-Lowke to come and witness a trial, and I told him I was prepared to make the little ship undergo any test he would like it to make. He kept putting off my invitation and finally said he frankly did not believe me. This made me very sore, as can well be imagined. Mr. George Sell, who was at that time at the High Holborn shop, could not help hearing our conversation, and asked me, when Mr. Bassett-Lowke had left, if he could come and see the little ship at work. We there and then fixed a day and in due course he came down to Hertford, where I was living at that time. I was only too pleased to show him the model at work, as he himself is a very skilful model engineer in all its branches and would be quick to detect any flaws. He would also be able to give me valuable advice. He came down, saw and was convinced that I had made no idle claims; he

agreed with me that I had substantiated my claim. I chuckled when some days later I received a letter from Mr. Bassett-Lowke asking if he could come and see a demonstration and bring Mr. Jas. Mackenzie. After making the little ship do three laps in succession, Mr. Bassett-Lowke tendered his sincere apologies and left Mr. Mackenzie with me so that I could explain to him thoroughly the whole plant. Mr. Mackenzie, later on, sent me a model destroyer in which to install a similar plant. This I did and on a test at Northampton the destroyer hit a mooring pole in the pond at full speed. Mr. Bassett-Lowke expected that the result would be a fine model display of a fire at sea, and, I believe, was disappointed that not only did the destroyer continue its voyage as if nothing had happened, but the only damage was a dent in the bows and paint chipped off.

I will now describe the scheme of the plant I use in all my boats. The opportunity to do this in detail and to use a model to illustrate the article is due to an accident which happened to one of my finished models. This model represents a free-lance design of a model cargo boat, which also carries passengers, say to the West Indies or South America. I lent it to an Exhibition and it had been replaced in its travelling case, which is a suit-case, and the model was packed into it with cotton-wool. Somebody laid the case on its side and for some unknown reason stepped on it. The result was broken masts and, worst of all, a damaged hull. When I opened the case I can assure readers there was a most profane silence. I told Mr. Mackenzie of the disaster and he was most sympathetic, as he also liked that particular model. His sympathy was practical and he offered to try to repair the hull.

His staff skilfully salvaged all the undamaged fittings of the decks, cut out the damaged portion of the hull and inserted a new piece, and at the same time increased the depth of the hull by half an inch. They did this because the only fault with the model as regards appearance was that she was a little low in the water. I had at the time to choose between stability and appearance. I chose the former. I was delighted with the repair effected, but, as at that time I was on the point of moving to Bishop's Stortford, she was repacked in her case ready for the move.



Section through the boiler.

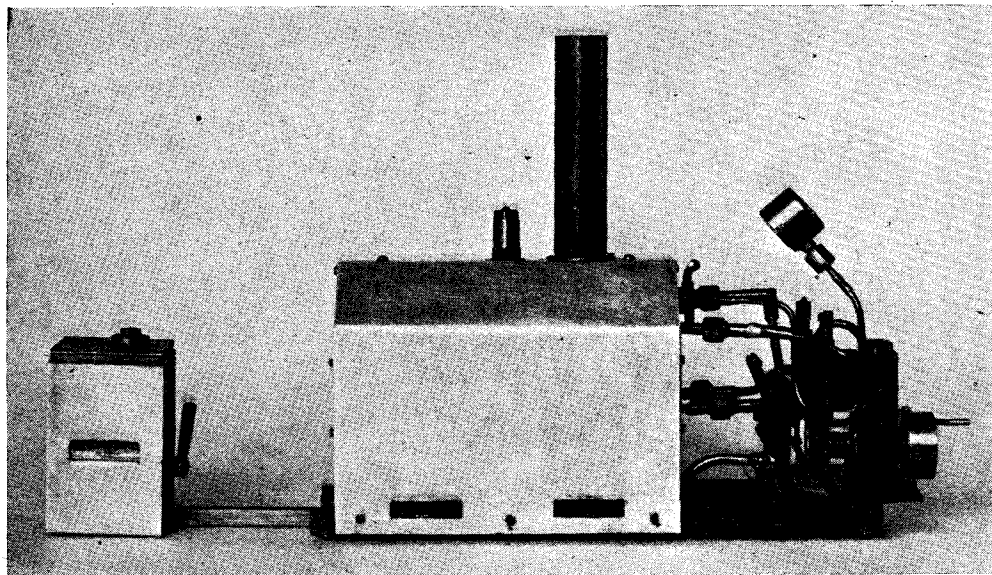
On arrival at Bishop's Stortford the re-erection of the model railway was my chief task. This has taken me about nine years to complete, and so the model steamer's existence was completely forgotten. A few months ago my younger son discovered it in the loft. I could not resist the temptation of seeing if the plant still worked. To my surprise the plant ran the very first time. My boy and I then examined all the fittings, roughly placed the decks in position, and it was evident that it would not be a difficult job to put the little ship in commission again and let her take her rightful place amongst my fleet. Due to the extra half inch in depth I was able to put some extra ballast on the

keel, and now she is a very stable craft. As she was still nearly stripped of everything I could easily remove the plant, and, also, by means of photographs, give illustrations.

The ship is 30 in. long overall, with a beam of 5 1/2 in. and depth of 3 3/4 in. to the main deck. She steams for 40 minutes, and, unless the lamp is kept low, she goes more like a destroyer than a cargo-passenger steamer. In one of the illustrations it will be seen the plant consists of a Bassett-Lowke banjo-type piston-valve engine 1/4-in. bore, 3/4-in. stroke. It is not a very marine-like looking engine, but I give it full marks as regards power and efficiency. In the photograph you will notice a small pump coupled to the engine. This is not a boiler feed-pump, but does duty as a bilge-pump. This refinement, if one may call it such, was fitted so that one could let the ship make a trip in real rough weather, and if any water got below it would be instantly ejected. On more than one occasion half-a-pint of water was poured into the ship while under way, and in a surprisingly short space of time it was pumped out. At one exhibition when she ran, one of my assistants kept on pouring tumblers of water down a hatchway and I am sure the junior members of the audience were hoping they were going to witness a wreck at sea, and were disappointed that nothing happened.

#### Boiler Details

The boiler is 4 1/2 in. long and 2 in. in diameter. The drawing gives the dimensions of the section through boiler and casing. The vent holes to the spirit lamp are seen in the photograph, and at the lamp end there is also an opening so that the lamp can be taken in and out for alteration. The spirit feed is on the automatic drip-feed principle, which was adopted for several reasons. First and foremost in a model steamer one does not want a quantity of spirit loose in the bottom of the vessel. With the automatic drip-feed, or the "chicken feed" as some call it, one can control the amount of spirit in the actual lamp itself. My aim is to have only a 1/4-in. depth of spirit in the sump if possible. This is ample for the wicks to burn at full power, and in actual practice this is sometimes exceeded. If there are waves on the pond on which the little ship is making a voyage and she pitches, spirit will surge into the sump from time to time and so raise the level above the 1/4 in., and there might be the danger of it overflowing. I have got over that danger by making a slot (1/16 in. wide) in the sump where it meets the wick feed-tube. This slot must go from the bottom of the sump to the top of the wick feed-tube. The latter is most important, for if the slot does not go to the top of the wick feed-tube and slight vaporisation



**The complete steam plant.**

takes place in the wick feed-tube the gases cannot escape, and I found that the spirit was blown back occasionally into the sump, which caused it to overflow. In spite of this precaution, there is still an inclination for the spirit to do a slight surge. It is, therefore, essential to make the sides of the sump as high as possible. The slot acts as a sort of dash-pot when the vessel pitches, as it has a retarding effect on the spirit flowing back into the sump, and when she pitches in the opposite direction the wicks have never shown any sign of overflowing, because in this case the slot in the sump also prevents an abnormal amount of spirit flowing to the other end of the lamp. It is important to see that when a plant is fixed in a model ship is on an even keel. This ensures that when steam is being raised the flow of spirit is steady and even. The flame naturally does not burn under the best conditions at that period. When running, the conditions alter because of the induced draught caused by the exhaust up the funnel. When the induced draught is working, the spirit is used much more rapidly. This eliminates any danger of the lamp overflowing if the spirit feed is in the bows, when the vessel squats due to the action of the propeller. All screw-propelled vessels are inclined to squat in a more or less degree when under way.

This acceleration of the evaporation of methylated spirit I have definitely proved on a model locomotive. At the request of a friend during a trial with a methylated spirit-fired loco.-type boilered locomotive, I

doubled the load. This made no difference to the speed of the engine, but the consumption of both spirit and water increased.

The next important point to watch is the height of the boiler above the top of the wick tubes. If this is not correct a vast amount of heat can be wasted and so cause excessive fuel consumption, or the heat not employed in heating the boiler can distribute itself over the interior of the hull and so raise the below-decks temperature to an undesirable point.

I found out the importance of the height of the boiler above the wick tubes with the little 18 in. long craft. At one time I came to the conclusion that the warping of the decks on this model was due to the excessive temperature below decks and decided to see how much I could reduce the spirit flame without impairing the steaming qualities of the plant, and I will not weary the reader with an account of the various lamps that I constructed during these experiments. The best lamp I found was one made with wick tubes of  $\frac{1}{8}$  in. to  $\frac{1}{4}$  in. internal diameter, spaced about  $\frac{1}{2}$  in. to  $\frac{3}{4}$  in. apart. The tube holding the wick tubes is made from rectangular tube made of about  $\frac{3}{64}$  in. to  $\frac{1}{16}$  in. thick brass; thinner tubing I found caused more surging of spirit in the sumps. In smaller ships, one elongated wick tube about  $\frac{1}{8}$  in. wide is quite successful, but in my opinion the multi-wick tube is better; the combustion of the flames seems better. Also, if longer than 3 in. the wick is more troublesome to adjust evenly. By the way, I use asbestos wicks on all my models.

*(To be continued)*

# Science at a Discount!

By "L.B.S.C."

A FOLLOWER of these notes, with a scientific turn of mind, wants to know whether it is possible to rig up a little steam-engine indicator on small-gauge locomotives, and follow one phase of big practice by getting miniature diagrams. I have received similar queries before, at odd intervals, so maybe, a word here on the subject will save further correspondence. The trouble is, that if you make an indicator to the smallest size capable of giving reliable diagrams, the comparative size of indicator to locomotive would be absolutely ridiculous, and the volume of steam required to operate it, nearly as much as would be needed to drive the locomotive—with your humble servant's valve gear and setting, anyway! The late Mr. Steadman Jackson was a "bit of a nugget" at this sort of thing, and he made a tiny indicator with a cylinder only  $\frac{1}{4}$  in. diameter. It "indicated" all right, but the diagrams were far from reliable, because the cylinder, whilst making very little difference to the volume of steam in the locomotive cylinder, had not sufficient power to operate the recording gadget properly. As I have so often remarked, Nature will *not* be "scaled"; and as friction is part of Nature, enough said!

## The "Laboratory" Side

The same correspondent suggests that I should deal with the scientific or "laboratory" side of the job in these notes. Golly!! The whole popularity of your humble servant's efforts with pen and pencil since September, 1924, has been due to the fact that I struck out on entirely different lines, making a clean break from the "orthodox," cut out all theory, calculation, dry-as-dust formulae, equations, cabalistic signs and what-have-you, and in plain straightforward (and I'll freely admit, sometimes superheated) language, gave instructions in full detail on how to build locomotives that would STEAM, PULL, and GO! I guaranteed results that had never been before achieved by following other writers' instructions, from Messrs. Pocock, Alexander and Co. right down to others whose names I have no need to mention. Folk reading them, exclaimed, "Why, that's *easy*!" and joyfully proceeded to buy castings, sheet metal, rod, tube, and so on. They diligently turned, filed, drilled, tapped, brazed, soldered, fitted and erected, and finally enjoyed the thrill of taking a ride behind their own handiwork, with the needle of the steam gauge going well around to the right and staying there, to the tune of

merrily-humming safety valves. Real glowing coal fires replaced feeble foul-smelling spirit lamps; sharp, healthy exhaust cracks replaced dull lifeless sighing, and the engines emerged from the "toy" or "model" stage—there's not much difference—to become *real* small editions of a full-sized locomotive, with all the principles and fundamentals of same, hauling living loads and keeping it up indefinitely, instead of making hard work of three or four coaches or wagons, and having to pause every couple of minutes or so to regain lost breath.

## Impossible?

When "Ayesha," as she became known, "performed the impossible" all those years ago at the Caxton Hall, and Mr. Marshall invited me to explain in this journal how it was done, had the explanation been made in scientific or laboratory jargon, accompanied by formulae and equations, very few would have bothered even to read it. The great majority would have been scared off, and concluded that my engine was a specialised job, incapable of being reproduced by the ordinary amateur locomotive builder. Well, it just wasn't, as you all know now; for dozens and dozens of readers have written and told me that previous to starting to build a locomotive, they did not even know how the steam pushed the piston up and down the cylinder, yet their engines worked first time of steaming, and did *more* than I claimed.

No, brother correspondent; I'm sorely afraid that if I followed your advice, 99.9 per cent. of the followers of these notes would cancel their subscriptions right away. Why, they even now start yelling out if I give too much instructional details, and ask for more lobby chats, reminiscences of the old days on the Brighton, and last, but decidedly not least, more of the adventures of that poor poverty-stricken kid whose only wealth was the "gold" he carried on his head, neck and shoulders. The trouble in chronicling Curly's doings is that this is a technical journal, and not a biographical record; and the most amusing and amazing incidents in the poor kid's life were not all connected with locomotives large and small, and therefore have no place in these pages. If I *liked* writing, instead of it being a burden, I would set out in a kind of biographical novelette, the story of my early life as well as I could remember it, from the earliest recollected incident, down to the time when I parted with my curls and went to work on the

railway; and I am sure that the mixture of joy, sorrow, smiles, tears, tragedy and comedy, all intermingled, would make a "best seller." I have related a few incidents in direct correspondence, which I guess have raised some smiles!

#### Mr. D. Picknell's "Princess Marina"

The reproduced photographs show progress on this engine up to the end of last May, and a close inspection will reveal what a fine job our worthy friend is making of her. Note the neat riveting on the smokebox and running-boards; also, the valve gear and the fittings in the cab. The boiler is lagged, and a proper cover made for the dome, with side pieces to house the top-feed connections. Since the photographs were taken, Mr. Picknell has fitted an injector made to the instructions I gave in past notes and the "Live Steam" book, as far as dimensions are concerned; but he arranged it vertically, putting the air release valve at the side, and fitting a disc valve to it, as I suggested in a subsequent note. This gadget works so well that he is relying on it altogether and is dispensing even with the tender pump.

The underneath of the engine is a proper box of tricks. In addition to the usual impedimenta, complete steam-operated brake gear is provided; but instead of the usual L.M.S. arrangement with steam entering the top of the brake cylinder (as on "Molly") the older system of steam admission below the piston is used. The top of the cylinder is open to the atmosphere, and the piston itself contains a ball snifting-valve. The idea is to reduce the "delayed action" time when steam is admitted to a cold cylinder. The operating-valve for the steam brake can be seen on the right of the cab.

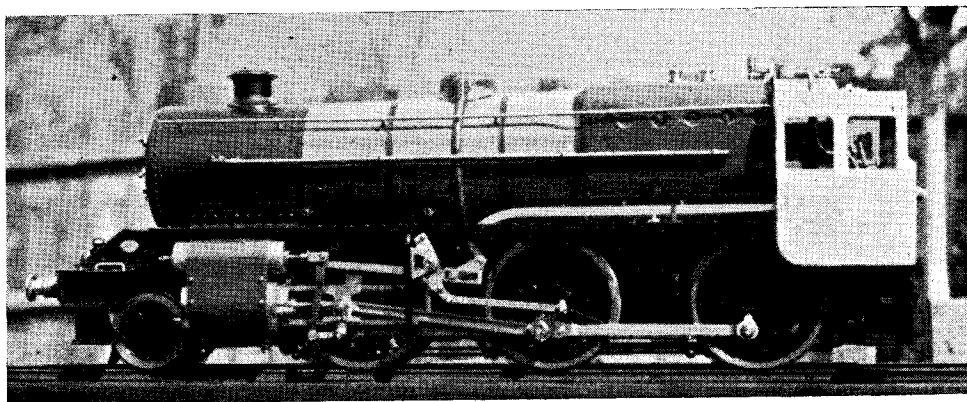
Mr. Picknell says that his line has been used for "Rainhill" testing, and confirms

all the claims I made for the ability of the tiny boilers to supply all the steam required. Rather a different tale from what happened on my own road the other evening, when a commercially-made job with a boiler twice the size, supplying smaller cylinders, and which cost £140, failed dismally, taking nearly fifteen minutes to raise steam to working pressure, and then losing the lot and konking out in one lap of the line!

#### Stovepipe Chimneys

Several correspondents have called attention to the recent note by Mr. F. C. Hambleton on page 17 of July 2nd issue, to the effect that stovepipe chimneys have a beneficial effect on the steaming properties of locomotive boilers, and say that if this is a fact, will it be reproduced on a little engine furnished with a similar chimney? All the stovepipe chimneys had disappeared from the Brighton Railway when I started work on the line, the old Craven engines which had them having all gone to the scrap heap, so I am not able to give first-hand information as to whether they improved the steaming or not; but I do know this; that several of the old London & South Western enginemen told me that the old Adams engines steamed better with the original stovepipes, than when fitted with the later type of bell-topped Drummond chimney. I heard also from the Great Eastern men that Jimmy Holden's engines were not so good with the later type of chimney; and more than one remarked that the "Claud Hamilton" class 4-4-0's, though they were good engines, would have been improved in steaming, if not in looks (though this is a matter of opinion) had they been fitted with original Holden stovepipes.

When "Bob" Urie took over on the L.S.W.R. he promptly reverted to the



Mr. D. Picknell's "Princess Marina."

stovepipe after his experiments with the first 4-6-0 mixed traffic engine, which had a chimney like a Drummond. The stovepipe is practically universal in Canada and U.S.A., and finds great favour on the Continent, in the Colonies, and in other parts of the world; so there doesn't seem to be anything wrong with Mr. Hambleton's note. Apart from the steaming, as there is no bell-top to catch the breeze and make eddies around the boiler, there is little need for any smoke-deflecting device, such as the ugly great side plates on the Southern engines. If the exhaust pressure is sufficient to lift the steam just clear of the rim, the breeze will usually do the rest.

Regarding stovepipe chimneys on little engines, all my boilers are pretty good steamers, and it doesn't seem to matter whether the chimney has a bell top or is plain; but among the engines I have built or rebuilt, "Fayette" 4-6-2, the "Caterpillar" 4-12-2, G.C. single-wheeler "Polly," G.C. 2-8-0, the American 2-6-6-4 "Annabel," 0-6-0 "Southern Maid" and the "O" gauger "Sir Morris de Cowley," all had stovepipe chimneys, and no fault could possibly be found with the steaming of any of them. "Tugboat Annie's" chimney is also plain, but as there is only  $\frac{1}{4}$  in. of it above the smokebox, there would be no room for a bell top in any case. However, when she runs on a cold day, the exhaust steam can be seen just coming out and drifting along the top of the boiler, the corners of the Belpaire firebox throwing it clear of the cab windows; it is quite plain to see that there is no sign of down draught, although the blast is so very light, even when running at the highest speed my south curve will allow, and in a good strong breeze. Sometimes, when running against the wind with an oil- or spirit-fired engine with an ordinary bell-topped chimney, I have seen a puff of flame come from under the firebox; but I would not say this was due to the shape of the chimney top, as the line is fairly exposed, and as a liquid fuel engine has no ashpan, any stray gust of wind could easily blow straight in under the firebox and momentarily deflect the flame, in spite of the action of blast and blower.

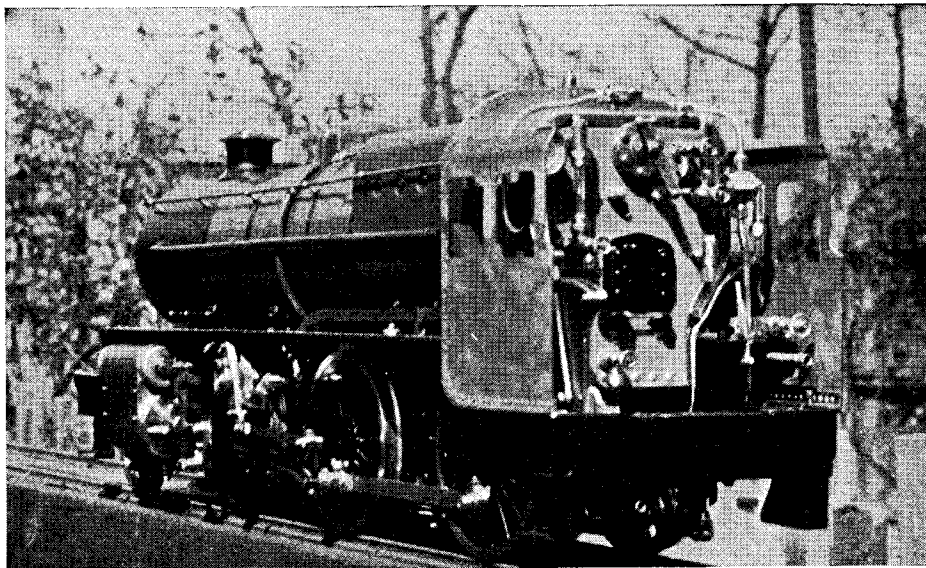
**Curly's Second Trip** (continued from page 520, last volume)

Just as the driver finished telling me about stopping at the Hudson's soap advertisement when running bunker first, the shunt signal dropped to "clear"; this was a little ringed arm on the main post underneath the junction dolls, which at night only showed a green light when "off," and none at all when "on." The driver said it was known as a "normally blind" signal. The guard

blew his whistle, and I was just going to start away when I noticed that the fireman had disappeared. "But please, where's Ned?" I asked. "Gone to see a man about a dog," said the driver with a grin; "we'll pick him up when we come back." I started the engine, and as we pulled around into the siding, he explained with much amusement that poor Ned had been eating bread and meat and sour pickles up at Shoreditch, and drank half a can of hot tea on top of it, so I could be driver and he would be emergency relief fireman during the shunting operations. The points at the run-around loop in the sidings were automatic, either weight or spring controlled (I forget which). I stopped at the spot he indicated, and then he said he would show me how to couple and uncouple, but I must never leave the footplate of an engine in steam without putting the lever in the middle and screwing the handbrake hard on; so I did that and we got down. He slacked the screw of the coupling for me, and I just managed to lift the shackle off the drawhook, then he told me to shut the air cocks on the brake pipe on both engine and carriage, and lift the air hose, which would come apart. It wanted some lifting at that, but with a big effort I did it, although the pop it gave when the coupling parted made me jump and made him laugh. Then there was the electric bell lead to unhook, and we were all ready to proceed to the other end of the train.

As we came out, a platelayer came along with a hammer and a long spanner over his shoulder. He looked at me rather amazed, and said to the driver, "Catching 'em young, ain't they, 'Arry?" As I was just getting up into the cab again, I didn't catch the driver's reply, but they both laughed, and the "navvy" proceeded on his way as the driver climbed aboard. I ran the engine to the other end of the train, and this time the driver did not tell me where to stop, as it was daylight and I could see what I was doing; but I took her very, very slowly indeed up to the carriages, holding the handle of the brake valve ready to throw it over as the buffers touched. When we got down, I got the shackle over the drawhook and screwed up the coupling all right, as the buffers were touching, but the driver helped me with the brake pipe, as the hose on the guard's van at that end of the train was new and stiff; and I had not, of course, got the knack of properly engaging the universal pipe couplings.

Whilst we were waiting for the signal to go back to the station, I thought of the platelayer's remark, and said to the driver, "Please, won't you get in a row for having me on the engine?" He said I needn't worry my curly noddle about that, for most



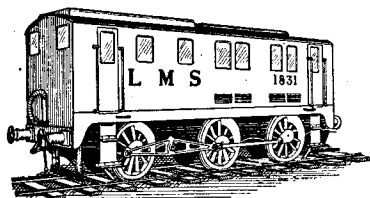
Fine detail work !

of the officials were like my friend the stationmaster, and even if any mean "something" reported it, the worst the district locomotive superintendent could do was to fine him a pound. But he added that that worthy was a darned sight more likely to put my name down for a job as soon as I was old enough to take it, than raise any fuss. I never found out the rights of it, but the "powers that be" *did* get to know, and apparently "winked the other eye," as the old saying has it; for when I eventually entered the Loco. Dept. just before I was sixteen (minus my golden mop) the shed foreman who put me through the colour test with signal lamps, remarked rather drily, "Seen these once or twice before, haven't you, Curly?"

I asked if I could make up the fire as I had seen Ned do it in the siding on my first trip, so the driver showed me how to hold and swing the shovel, but he would only let me take a small amount of coal on it, saying that although I was abnormally strong, I should not risk straining my undeveloped muscles. So I put a few teaspoonfuls down each side, in the back corners, and under the door, and felt quite an expert when my last consignment plonked against the front tubeplate under the brick arch.

After a few minutes, the signal went "off," and as I dropped the lever into full gear and took hold of the regulator handle, that peculiar feeling that "got" me first time at Shoreditch on the previous trip, came back. It seemed as if the little engine *knew*, and

was giving Curly a sign, and I felt very proud and happy. With a few hearty puffs, we left the siding and pulled into the platform, where Ned was waiting, having by the look on his face, concluded the business about the dog to his entire satisfaction. He had a surprise when he looked into the firebox, and said if I could put the coal in the same place when the engine was running, I wouldn't have much to worry about. The days now being longer, there was still plenty of daylight left, so the driver said I could take the engine as far as Deptford Road "on my own," as I knew the few signals up to that point; and he sat down on the trailing sandbox behind me, with the remark that I needn't be afraid, he wouldn't let me go wrong. So when the guard's whistle gave the "Right-away" down the platform, I looked back in "professional" manner, saw him wave his flag, and then "did the doings." As *Stepney* merrily puffed over the bridge spanning busy Rye Lane, it was a just as proud, but far more confident—and grubby!—Curly who horsed up the lever next to middle, shut the blower, and peered intently through the cab window for the Queen's Road signals. We got to Deptford Road all right, with only one mistake; I made the brake application too soon after passing the canal bridge, being over-cautious, and had to release fully and make a second application, losing half-a-minute or so by the slow approach. How I got on with firing in the tunnels, and learning the tunnel signals, I'll have to defer to the next instalment,



\* EDGAR T. WESTBURY'S

**1831**

## Cutting the Transmission Worm Gearing

**A** PART from the use of change-speed gearing in the transmission system, some form of positive speed-reducing gear is practically a necessity in any vehicle propelled by an internal combustion engine, as the revolutions per minute of the latter, when running efficiently, are invariably much higher than those of the road or track wheels. Small toothed gearing, which is generally the most convenient means of obtaining the required speed reduction, is liable to be very inefficient, but in some cases the loss of power in the gearing can be tolerated, if only a modest performance is expected of the vehicle, and a good margin of power is provided by the engine. This applies generally to slow-moving vehicles such as tractors, mobile cranes and transporters, and the like; in the case of the "M.E." Road Roller, for instance, it was not considered that high transmission efficiency was a matter of paramount importance.

### A Different Problem

But a locomotive, which is designed with the primary object of hauling heavy loads at fairly considerable speed, presents a totally different problem in the above respect, and it is necessary to avoid any undue mechanical losses in the transmission gearing, and also to design the latter so that it will stand up to heavy torque loads, and additional stresses caused by shock or impact. The desired objects may be obtained in two ways: (1) by employing the most efficient form and arrangement of gearing possible, and (2) by reducing the number of gears and stages in the reduction train, to the minimum.

Dealing with these considerations in turn: (1) careful consideration has been given to the respective merits of all the known forms of mechanical reduction gearing. (As pointed out in the introductory article on the design of the locomotive, other forms of transmission than mechanical gearing, i.e. hydraulic or electric, have been ruled out in the present model, for reasons explained at the time.)

Spur gearing, which can be produced fairly easily, and made to work reasonably efficiently in practically any size, did not

lend itself readily to the particular arrangement of change-speed gearing adopted, and much the same applies to sprocket and chain drive, which is also capable of working efficiently if properly arranged. (It should, however, be noted, that spur and chain gearing, in conjunction, were used very effectively by Mr. Ripper in his experimental locomotive). Bevel gearing might have been adapted to a somewhat similar arrangement of change-speed gear to that actually used, but would have necessitated certain modifications in design which would introduce practical difficulties. Moreover, small bevel gears are extremely difficult to produce in an efficient form, and demand the most accurate mesh adjustment of all gears in order to obtain smooth and silent running. The only other alternative is to employ worm or skew gearing, the latter being really a variant of the former, which is extensively used because it can be produced readily on machines which are available in practically all well-equipped machine shops.

Regarding point (2), worm gearing is also desirable because it enables a wide range of reduction ratio to be obtained in one stage, and within restricted dimensions in respect of shaft centres or overall space occupied. In the present case, only a single pair of gears is employed, so that the gear train is reduced to its simplest possible proportions, and "stage" losses thereby kept down to the minimum. It will readily be appreciated that the latter point is of the highest importance, because, assuming that the transmission efficiency of a pair of gears is 75 per cent., the remaining 25 per cent. being lost in, friction (these figures are purely arbitrary, but may be regarded as more or less typical for small gears), the use of a second stage in the train will cause a further loss *in the same proportion*, so that the ultimate mechanical efficiency is reduced to 56.25 per cent. Further stages will, of course, involve still greater losses.

### Skew Gearing

The use of skew gearing is quite practicable in this transmission system, as its efficiency is fairly high, providing that it is accurately cut, and that it is not overloaded. This form of gearing is usually produced with the aid of a universal milling machine (except in cases where large quantities are required,

\* Continued from page 124, "M.E.," August 6, 1942.

when special-purpose machinery would enable it to be done more speedily and economically) and in the event of anyone undertaking to supply the gears ready-made, it is probable that they would find it easiest to make gears of this type. For one thing, they could be cut in batches, or in a long length, with the teeth cut from one end to the other, and subsequently parted off; this would save considerable time and trouble, as compared with making each gear singly. So far as the specification of the gears is concerned, I have already explained that a fair latitude in the reduction ratio is permissible. It has, however, been decided, as a result of experiments, that something between four and five to one reduction seems to suit the

### Cutting Skew Gears

Skew gears can be cut on a screwcutting lathe, with the aid of a rigid and powerfully-gearbed milling spindle, providing that a suitable train of gears can be set up to produce the pitch angles required. This may be found extremely difficult, however, with the range of change wheels normally provided with small lathes, which are only intended to cover the requirements of ordinary screwcutting operations. Most lathe makers can supply extra change wheels which will extend the range of gear ratios obtainable, but whether it is worth while to go to the trouble of ordering them for dealing with emergency operations is a debatable point. Several contributors to

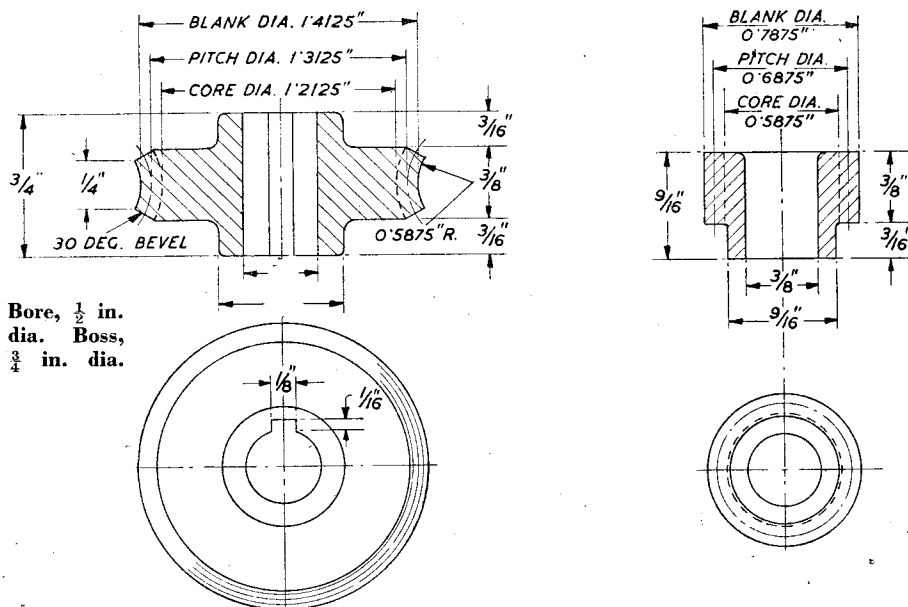


Fig. 130. Blank diameters of worm-wheel and pinion.

engine best. The pitch of the teeth may also be varied to suit the equipment available, but should not be less than six on the pinion and twenty-four on the larger gear; the most convenient pitch angles are approximately 60 and 30 degrees to the axis, respectively. In only one respect is there a tight restriction on the gear specification; that is in the distance apart of the shaft centres, which should not exceed  $1\frac{1}{2}$  in. If this figure is exceeded, it will be found to interfere with the ease of removing the transmission gear from the sub-frame, which is normally accomplished simply by removing the undershield and the four holding-down bolts, and is an extremely desirable feature to facilitate overhaul or adjustment of the gear without dismantling the entire chassis.

THE MODEL ENGINEER have described methods of skew gear cutting, a notable example being Mr. Latta's articles on cutting a pair of skew timing gears for a workshop petrol engine a few years ago. I do not intend to go into this matter in exact detail, because everything depends on what equipment is available in a particular case, and scarcely any two workshops are alike in this respect. The technique of skew gear cutting, and calculations for pitch angles, cutters, etc., are dealt with in several standard text books, including the Brown and Sharpe milling machine handbook; this applies to the use of the universal milling machine, but can be adapted to carrying out the operation on the lathe, by taking into consideration differences in the change wheels and the pitch of lead screw.

When using the screwcutting gear to produce steep pitches, it will be impracticable to drive the headstock in the normal way; the train of wheels must be driven from the lead screw end, and if no feed handle is provided on the lead screw, a temporary one must be fitted. Some form of indexing gear, capable of dividing out the number of teeth required in each gear, must be provided on the lathe mandrel, and arranged so that it can be used without interfering with the gear train.

From this description, it will be seen that there are quite a few practical problems to be dealt with in cutting skew gears, and many readers may consider the undertaking a very formidable one; I have therefore devoted a good deal of time and thought to evolving simpler methods of producing gears which will serve the essential purpose.

### Merits of Worm Gearing

When the matter of the gears was first discussed, a good many readers went to some pains to point out to me the superiority of worm gearing over skew gearing, in some cases quoting efficiency figures which I shrewdly suspect were lifted *en bloc* from certain well-known statistical text-books on the subject. Let me say at once that I do not for an instant dispute these figures; I have no doubt that they were compiled with the greatest care, and from the results of actual tests. But I have more than a faint doubt that they are capable of unqualified application, especially in such cases as that with which we are now concerned. It is often said that figures cannot lie; this is indeed a self-evident fact, since figures, in common with other inanimate objects, such as documents and photographs, have no volition, and are consequently incapable of the intention to deceive. But the *interpretation* of figures is a matter of individual inference, and thus they may become a means of conscious or unconscious misrepresentation.

In actual practice, the efficiency of any kind of gears depends far more upon the accuracy with which they are cut and adjusted than on any other factors, including that of formula and design; and it follows therefore, that small gears tend to be less efficient than larger gears, because, although their dimensions are smaller, the limits of error in producing them cannot be reduced in similar proportion; and the more complex the process of generating the gear, the more likelihood there is of errors being introduced, and the greater the difficulty of detecting them. In most cases where small worm gears are used, a comparatively low standard of efficiency is tolerated, because attention is not, as a general rule, forcibly drawn to

inaccuracy, as it is in other forms of gears, which tend to cause noise or vibration when badly cut or adjusted. Worm gearing can nearly always be made to run silently, and abnormal end thrust can be dealt with by suitable bearings, so that its low efficiency often passes unnoticed. Many small worm gears which are very roughly cut, or inaccurate in tooth form, serve their intended purpose fairly well.

The common forms of worm gearing can only be used to transmit power from the high-speed to the low-speed shaft, and are thus incapable of being used as a speed-increasing gear, owing to the small pitch angle of the teeth. But in gears having a steep pitch angle, it is possible to use either shaft as the drive shaft, and thus to decrease or increase the speed as the case may be. In the latter case, inefficiency in the gearing, whether caused by inaccuracy or poor finish of the teeth, shows up very prominently, and the "reversibility" of such gearing is often regarded as a fairly sound proof of efficiency. (The term is in this case used to denote a change-over of the driving and driven shafts, not merely a change in the direction of rotation, which is, of course, possible with any normal form of toothed gearing.)

Although the transmission gear of a vehicle is never required to work in the reverse direction for the actual transmission of power, it is essential that the worm wheel should be capable of driving the worm, to prevent the locking of the driving axle when the vehicle over-runs the engine, as when coasting on its own momentum, or on a down grade.

### Producing Worm Gearing

In the normal production of worm gearing, the cutting of the worm is usually a more or less orthodox screwcutting or thread milling operation, while the worm wheel is cut by a hobbing process, either with or without preliminary gashing of the teeth. The basic principles of both methods must be adhered to in gears of any size which are required to be accurate and efficient, and it is therefore necessary to devise some means of applying them to the lathe, as this is the only machine tool normally available to the average amateur.

The worm involves the cutting of a multi-start thread of suitable tooth-form to act as a gear; not a very easy operation, but one well within the capacity of an ordinary screwcutting lathe, providing that a suitable train of gears can be set up to produce the required pitch angle.

In most cases where worm gears are cut in the lathe, the hob is rotated between centres or in the chuck, and the wheel blank is mounted on a vertical arbor,

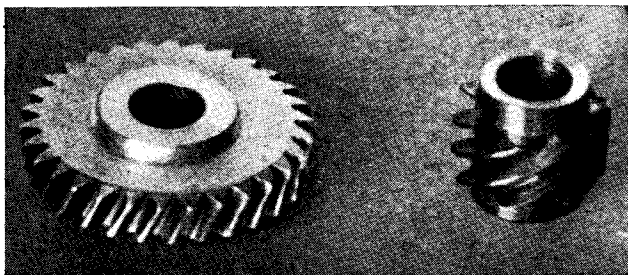
capable of free rotation in some form of fixture attached to the tool post or crossslide. The hob, which is essentially a replica of the meshing worm provided with cutting teeth, engages with the gear blank

and propels it round so that all teeth in the latter are cut gradually and progressively as the fixture is fed in towards the hob. This method gives quite good results on the usual forms of high-reduction gears, especially when the blanks have the teeth partly formed by preliminary gashing; it is, however, often attempted more or less successfully without gashing, though the results can never be guaranteed consistently successful, for reasons which need not be discussed here, but are readily apparent when the principles of the operation are discussed.

The gashing operation is usually carried out with a flycutter or formed milling cutter, of a shape which is close enough to that of the finished tooth space to provide the hob with a well-defined path to follow. When gashing is done in the lathe, it is usual to employ some form of milling cutter spindle, in conjunction with an indexing device, the procedure resembling that employed in spur gear cutting, except that the teeth are cut at an angle, and the feed is towards the blank centre instead of across its face, so that a concave section of tooth is produced. Methods have, however, been devised for gashing worm wheels by means of the hob itself, in conjunction with the screwcutting motion of the lathe, and an indexing device on the vertical blank arbor.

In the experiments which I made with a view to evolving a simple method of producing the worm gear for this model, I found that the usual gashing and hobbing methods do not work out very successfully when applied to worm wheels having a very steep tooth angle—i.e. “reversible” worm gears. The reason for this is that excessive side thrust is necessary to propel the blank, and the hob thus tends to cut away one side of the tooth to an abnormal extent. In other words, the hob tends to “slip”—like a stalled propeller, and for very much the same reason—and, it is sad to record, not infrequently succeeds in doing so, with the result that “dental casualties” are caused!

It has been suggested by several readers that this trouble might be avoided by using



**An experimental worm-gear and pinion, of size and type suitable for the transmission gearing of “1831.”**

between the pitch angles of the single-start and multi-start worms. While it is possible to cut quite a nice-looking worm wheel—and one which might work, after a fashion—by this method; the fallacy in the principle is that the true tooth form can only be produced by a cutting tool which follows exactly the same spiral path as that of any individual tooth of the meshing worm. Any other method might possibly produce a tooth of the right *section*, but not the right *rate of twist*, so that proper contact of the worm and wheel could not be obtained.

I do not state that the problem of applying a “self-propelling” hob to the required form of worm wheel is an insuperable one, but simply that I found quite a lot of practical snags in it, and that, as a result, I do not feel justified in recommending it as a reliable method for the constructor who lacks specialised experience in these matters. In actual fact, I found it far simpler to find a means of rotating the worm gear blank *mechanically*, at the necessary rate to match the pitch of the hob. This is, of course, the obvious method, and the one which is invariably used in gear hobbing machines; but most workers who have attempted to cut gears in the lathe have considered it far too complicated for adaptation to this purpose. The fittings which I have devised for carrying out the operation are, however, quite simple, and the lathe change wheels provide the necessary gear train. Gashing, as a separate and distinct operation, becomes unnecessary, so that there is no need for the use of indexing gear and milling attachments.

While it would probably be unduly presumptuous to claim real originality for any device or process carried out in the lathe since the days of Holtzapffel (who seems to have covered every possibility in this direction pretty thoroughly), I have an idea that few readers will have seen anything like it before. I have, however, discovered, since evolving the device, that worm gears have been produced commercially by somewhat similar methods.

*(To be continued)*

a single-start hob to generate the teeth, instead of a hob which is a replica of the meshing worm. The arbor holding the blank would in this case have to be arranged at an angle corresponding to the difference

# Monotony in the Workshop

By PERCIVAL MARSHALL, C.I.Mech.E.

ONE very marked difference between the machine shop of the old-time general engineering works and the same department in the modern specialised mass production factory is the monotonous repetition character of the jobs which are now so often allocated to a particular lathe or machine tool. At one time a turner or machinist might have a dozen different jobs to do in the course of a week. Each piece of work presented its own features of interest and called for its own degree of accuracy, or ingenuity in setting-up or tooling. Now-a-days a lathe or machine hand may be doing exactly the same job week in and week out, and he may be so equipped with jigs and fixtures or special tools, that the accuracy and setting-up of the job is determined for him without making any special call on his own experience or ingenuity. There is a great psychological difference in the frame of mind in which he approaches his day's work as compared with his predecessor. In the one case he felt that he was a craftsman and that his skill and resource were to be tested in an interesting way. In the other case he feels that he is merely operating a machine which is designed to turn out so many exactly similar pieces in a given time. His primary anxiety is to earn a living, and he usually reconciles himself to the monotony of the work, partly because it makes but little demand on his intelligence and partly because of the satisfactory nature of the contents of his pay envelope.

## Repetition Work in America

I remember hearing many years ago of the experience of a well-known machine tool manufacturer in America who encountered the reluctance of skilled turners to settle down to prolonged runs of repetition work. He found that such men got very tired of machining similar pieces over and over again. They would throw up their jobs and seek employment where they could be sure of a more interesting and varied run of work. His method of overcoming this production difficulty was to take a labourer who was earning a mere pittance in sweeping up the shop. He would train this man to do a one-piece job in the lathe, and would then keep him so occupied at a rate of pay considerably in advance of his wages as a shop sweeper. The labourer was satisfied to do the monotonous work without grumbling,

because it not only improved his status as a worker, but it substantially increased his earning power.

## A Personal Experience

A little experience of my own comes back to me as I write. I was working as an improver on a lathe in an engineering shop where air-compressors for torpedo-boats were a regular line of production. Gunmetal hand-wheels for stop-valves were required in large numbers, and one day a large basket full of castings for these wheels was deposited beside my lathe, each to be bored and turned. I steadily worked on them for some ten days or a fortnight until they were finished. I cleaned up my lathe, reported to the foreman, and looked round hopefully for some work of a different kind. But a second load of exactly the same castings arrived, and I felt rather glum. However, I raised a smile, and went to work again, but not quite so cheerfully as before. This lot having been disposed of in due course, I felt that I did not want to see any more hand-wheels for a long time to come, in fact I did not care if I never saw one again. But to my horror a third large consignment of exactly the same wheels was dumped down beside me, with a grin on the face of the labourer who brought them. This was more than I could stand, and though I did get half-way through the heap, I asked to be paid off at the end of the week. I was probably rather foolish to take this view of my work, but I was young and impetuous; and more anxious to gain a varied experience than to make money. It did, however, bring home to me the boredom of repetition work, and a sympathy with those who are through force of circumstances restricted to a monotonous type of job.

## Conditions in the Home Workshop

Conditions in the home workshop are rather different. The model engineer may be faced with the necessity of making a large number of similar parts for his model. He can make these parts at his leisure, and can at any time take up some other work between while to give him a change of interest. Moreover, a repetition job gives him the opportunity of devising and making special jigs or tools for the work, which is an interest in itself, and a source of satisfaction as he observes the expedition and efficiency with which the parts come out of the lathe or machine on which he is working.

# \*Small Capstan Lathe Tools

Notes on "tooling up" for repetition work, with special application to the "M.E." small capstan attachment

By "NED"

THE majority of small capstan lathes are equipped with a cross slide having tool posts at front and rear, so that either direction of cross traverse will bring one of the tools into operation. In some cases the usual form of screw feed is employed to traverse the slide, and in others a lever is used, operating the slide either through a link, or a rack and pinion. The cross slide is usually mounted on a short saddle which is adjustable in the longitudinal plane of the lathe bed, but is not normally equipped with any means of traversing in this direction. Certain types of capstan lathes, however, can be provided with attachments whereby one of the cross-slide tools may be traversed, sometimes by means of a supplementary swivelling slide, comparable to the usual "top slide" of a centre-lathe; but this motion is but rarely required in normal production of small parts.

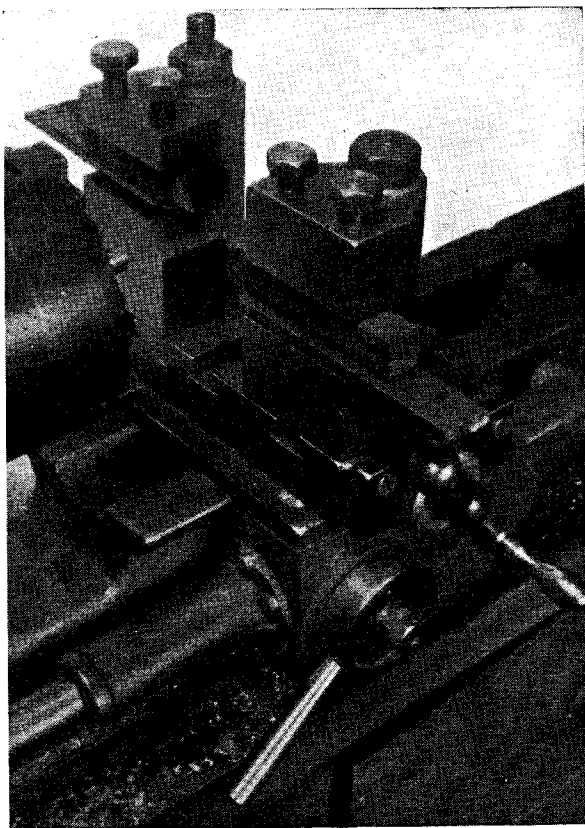
In lathes which have been converted or adapted for production work, the normal cross-slide motion can be utilised, provided that an extra tool post can be fitted at the rear end of the slide. The front tool may be carried in the usual way, by the tool post on the top slide, and this method enables the latter to be used

as an extra traversing motion. But in the majority of cases, its use is neither necessary or desirable; very often the room taken up by the top slide and its feed handle may seriously impede the movement of the capstan head tools, while there is always a possibility of the slide being moved inadvertently, thereby interfering with the setting of front tool, and possibly spoiling a run of work before the discrepancy is discovered.

From many points of view, therefore, the use of a solid tool post, bolted to the front end of the cross slide in place of the top slide, is much to be recommended. Thus it is worth while to make up two special tool posts, one for the front and one for the rear

tool, and attach them to the cross slide in the manner most convenient in the particular case. The saddle carrying the cross slide should be clamped to the lathe bed; in most small lathes the only way of doing this is by tightening up the slide-adjusting jib strips.

The most essential features of the tool posts are that they should be capable of holding the tools rigidly, and in the required positions. Exact drawings of suitable tool posts are not given, as the requirements of different types of lathes vary considerably; but in most cases their design is



Specially made front and rear tool posts mounted on a 3-in. lathe.

\* Continued from page 93, "M.E.," July 23, 1942.

quite simple, and they may be made either from mild steel bar of square or rectangular section, or from iron castings. It will, of course, be clear that the slot or groove to carry the tool must be higher in the rear tool post than in the front one, as the tool is set in an inverted position in the former case; apart from this, the two tool posts may be practically identical, so long as the cross slide design allows of mounting them both in the same way.

Most of the popular model engineers' lathes have a flat-surfaced cross slide, provided with tee slots; and generally speaking, nothing could be more convenient

sary to consider how much room is required between the tools to allow the capstan head tools to operate on the work.

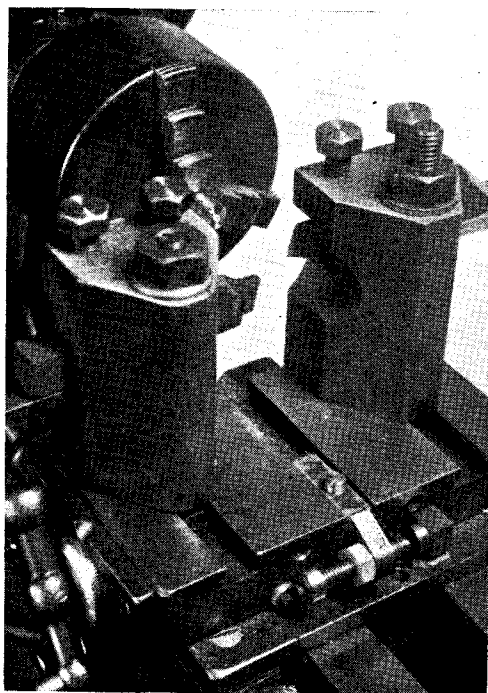
If, however, it is necessary to deal with work of larger diameter, some provision for offsetting the tool posts will be found desirable; but this should never be overdone, as offsetting the tool post from its centre of support is bound to impair its rigidity to a certain extent. It may be found that only the rear tool post needs to be offset to obtain a sufficiently wide span for dealing with all the production jobs likely to be handled.

Another limitation, which is likely to be found in small lathes when using two tool posts, is in respect of the length of cross slide traverse. It may be found that in the 3-in. lathes, the rear slide cannot be run back far enough to enable the tool to clear the work; offsetting one or both tool posts is only a partial remedy, because extra clearance entails the need for longer traverse, as a matter of course.

In lathes of the type under consideration, however, it is possible to extend the normal travel of the cross slide without drastic alteration. As expedients for this purpose have already been described by other contributors in the "M.E.," it is unnecessary to deal with this matter in detail; but briefly, it may be said that the only alteration to the slide consists of fitting a new bridge, or keep plate, to take the thrust of the feed screw. The keep plate, on the lathes in question, is simply a flat plate attached to the front of the slide, and bored in the centre to form the feed screw bearing. If this fitting is altered so as to form a bridge, to carry the feed screw bearing some distance beyond the front of the slide, the latter is thus enabled to travel farther back before the thrust collar of the screw runs home against the slide way of the saddle. To take full advantage of this alteration, it would be necessary to make a longer feed screw as well; but even without this, it is well worth while, not only for adapting the lathe to production work, but also on the grounds of general adaptability.

The two tool posts shown in the photograph were produced by Mr. Ian Bradley, whose articles on workshop topics are well known to readers. Although he is not specially concerned with the adaptation of the lathe to production work pure and simple, he has a keen appreciation of the utility of these fittings in general lathe work. The use of the front tool post is recommended, on account of its excellent rigidity, for all purposes except those which call for the swivelling motion of the top slide, i.e. taper or bevel turning. The rear tool post

*(Continued on next page)*



**View of tool posts from tailstock end, also showing adjustable cross-slide end stop.**

for mounting the special tool posts. The 3-in. lathes, which are perhaps the most popular, and for which the "M.E." capstan attachment was primarily designed, have three tee slots in the cross slide, and the bolts holding the tool posts may be anchored in the front and rear slots respectively. This arrangement is inclined to be a little cramped in cases where simple forms of tool posts are employed, but allows sufficient room between the tools for dealing with bar work up to about  $\frac{1}{2}$  in. diameter, and has the merit of avoiding excessive overhang of the tool from its support. It is, however, neces-

## Brazing and Hard-Soldering Aluminium

IT is frequently asked by model engineers why, if aluminium cannot readily and effectively be soft-soldered, it cannot be brazed. Aluminium is without doubt one of the most difficult metals to braze effectively. This is largely due to the difference in the fusibility of aluminium oxide (3,000 deg. C.) and aluminium metal 658 deg. C. From a mechanical point of view, to attempt to braze aluminium is a mistake; the metal is far more likely to fuse than many of the brazing alloys employed.

The coefficient of expansion of aluminium is considerable and a model component may be rendered worthless owing to the deformation it has received during the brazing process. The essentials of a brazed joint are the contact of absolutely clean surfaces free from oxide and dirt, and the bugbear to successful brazing is the difficulty in eliminating the oxide layer that is so refractory at brazing temperatures, and effectively prevents the essential intimate connection between the brazing metal and the surfaces to be joined.

A number of experiments were made by the writer some months ago with the brazing of various sheet aluminium model components. Several types of joints, brazing alloys and fluxes were employed. The results were unsatisfactory in that fusing of the aluminium took effect before a perfect joint was obtained. Obviously the brazing of aluminium, strictly speaking, is at present far from being a satisfactory

commercial proposition; yet aluminium is one of the most readily weldable of all metals, and the metal can be successfully hard-soldered.

The solder used in hard-soldering aluminium is an alloy of aluminium having a melting point of approximately 550 deg. C. Many such alloys exist, but the silicon alloy containing 10 to 13 per cent. of silicon is best. The oxide film is removed by means of an alkaline halide flux. At the temperature which the soldering is effected the flux is melted and rapidly attacks the oxide layer, permitting the liquid solder to come into contact with clean aluminium and to alloy with the metal. An atmospheric gas blow-pipe flame is used, but, apart from this and the higher temperature employed, the process does not differ from the ordinary soldering of brass or copper. The flux is applied on the end of the solder strip or bar, which is melted up and flows readily, soldering the parts together. Silicon alloy solder may be obtained in the form of a tube with the flux contained inside. The art of hard-soldering can be recommended for ease of application, giving permanent joints and strength. Unlike soft-soldering, a hard-soldered joint can withstand the action of boiling water or steam. As evidence of the simplicity of the process it may be mentioned that one large manufacturer of aluminium hollow-ware has employed girls for soldering spouts to kettle and teapot bodies.—A. J. T. EYLES.

## Small Capstan Lathe Tools

*(Continued from previous page)*

is less constantly in use, but all turners will realise the advantage of being able to keep a parting tool ready for action when turning small parts from bar stock—even though they may be dead against “mass production” in the home workshop!

It will be seen that in this case both tool posts are substantially alike, but in the rear tool post, clearance for the tool has been increased by machining a concave groove across the front of the tool slot. These components are well on the massive side for the duty they have to perform, but it is a good fault, and the use of two substantial set screws in each post undoubtedly ensures that the tools will never alter their setting under any normal stress.

Smaller tool posts would, however, be quite satisfactory for most light capstan lathe work, and the use of a single set screw would also suffice, so long as the tool is bedded home against the side of its slot. The bearing surface of the bottom of the post should, however, be kept fairly large, and thus there is much to be said for the use of tapered (“bottle-jack” or “light-house”) types of tool posts. An adaptation of the familiar “American” type of tool post is also well worth consideration; the special advantages which this type offers in respect of tool height adjustment will appeal to many readers, but the central tool slot may restrict the section of tool which can be accommodated, and may also limit the ability of working close up to the chuck with a tool of normal shape.

*(To be continued)*

## New Lines in Small Tools

**M**ODEL engineers scarcely need to be reminded of the difficulty of obtaining even the standard kinds of small tools, much less the out-of-the-way "special" lines, under the present conditions. Many of our advertisers are doing their best to keep up the supply of essential tools and materials, but it is an uphill struggle, and the demands of war industry, which must obviously be first served, often exhaust all available stocks. But the model engineer is, in very many cases, performing a small but by no means insignificant part in the scheme of national service, and in such cases his demands are by no means idle or selfish ones.

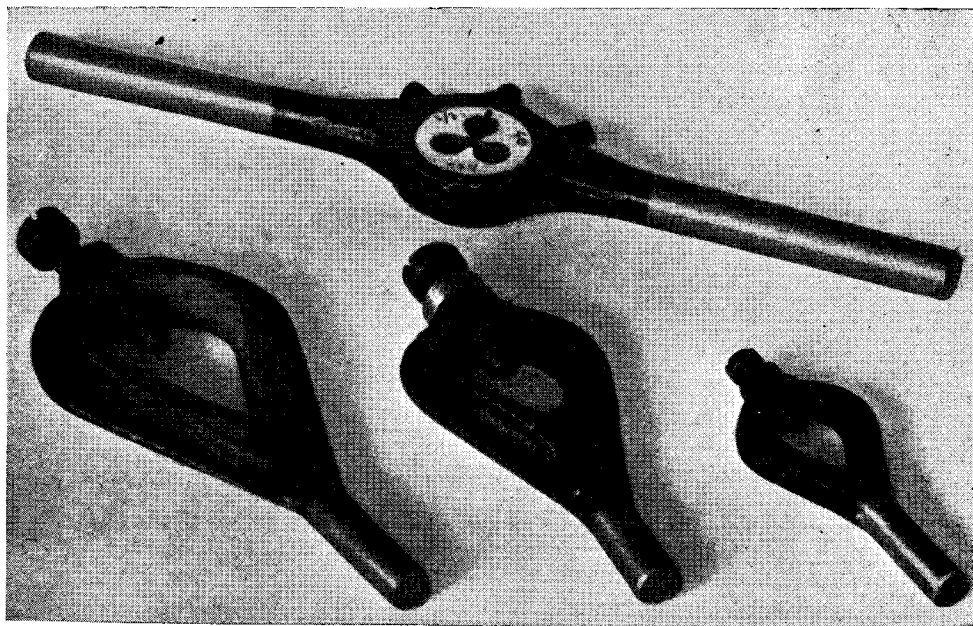
Some supply firms whose time or products have not been entirely monopolised by official orders have, however, been able to devote some attention to fulfilling the requirements of the amateur, though the problem of introducing new lines in wartime is complicated by restrictions in the supply of raw materials. Castings and forgings in certain metals are absolutely unobtainable without special licence, and substitute materials have to be pressed into service.

Our attention has been particularly drawn to this matter by reason of some new items in small tool equipment recently introduced by the Gordon Instrument Co., Clinton Place, William Street, Sheffield. In this case, the usual steel forgings which were

formerly employed for these particular tools have been replaced by castings in bronze and gunmetal; but from practical tests of samples submitted to us, the actual utility of the articles for their designed purpose does not appear to have been in any way impaired. There may, indeed, be advantages in certain cases in using these materials, as they completely eliminate the rust problem which looms largely in the home workshop.

Our photograph shows a set of three lathe carriers, sizes to take  $\frac{1}{2}$ -in.,  $\frac{3}{4}$ -in. and 1-in. stock respectively, in gunmetal, and a die-stock to take 13/16-in. circular dies, which have all been found satisfactory in use over a period of some two months. We are informed that new lines are under consideration, and enquiries are also solicited either from the trade or individual readers in respect of any lines in tools or equipment which may be suitable for manufacture in similar material.

This policy appears to be a very commendable one, and although many readers would very likely prefer their tools to be made of the orthodox materials, and perhaps to bear a well-known trade mark, the use of serviceable substitutes will not only help to relieve many a "bottle-neck" in the model workshop, but also lighten the burden of those tool dealers and manufacturers who are seeking to supply twice the number of customers with one-tenth the amount of goods they would normally handle.



A circular die-holder and a set of carriers, in bronze and gunmetal, by the Gordon Instrument Co.

## ★ Model Aeronautics

## An Early "Wright" Biplane

ONE of the most characteristic details of the Wright machines was the transmission from engine to propellers. This was effected by means of ordinary bicycle chains, running through guides of bicycle tubing, and engaging, at the propeller end, upon bicycle chain-wheels. The whole was brazed up with lugs, in the approved bicycle fashion; in fact, the complete system is very reminiscent of the Wrights' early connection with the cycle trade. As the propellers ran in opposite directions to each other, it was necessary that one of the chains be crossed, thus requiring a very long run of chain upon that side. By placing the engine to one side of the cockpit, this was made possible, with the additional advantage that the engine weight balanced, to some extent, that of the pilot.

Although chain transmission is efficient, neat and light in weight, it is unsuitable for drives of great length, yet it seems to have worked uncommonly well in this instance.

\* Continued from page 142, "M.E.," August 6, 1942.

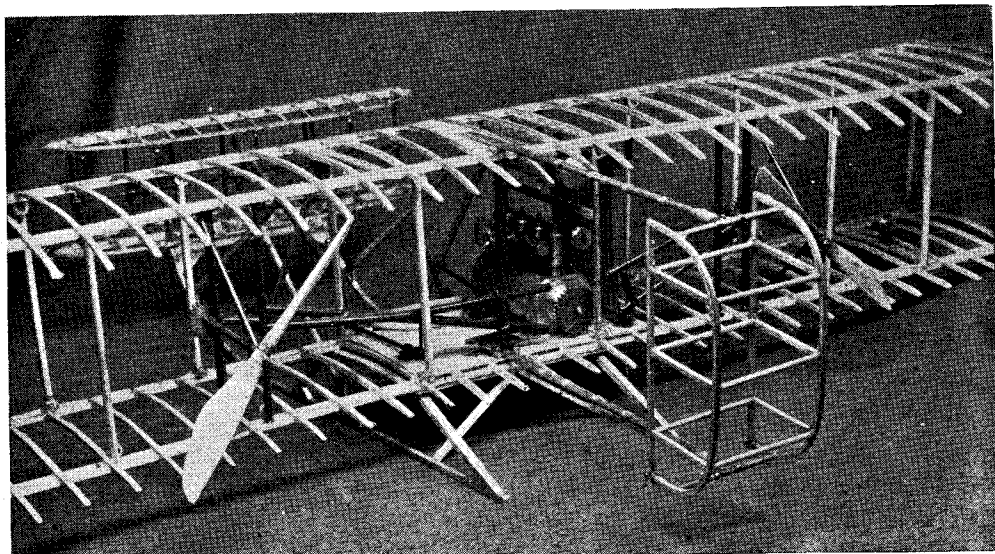
**Mr. Lawrence H. Sparey deals in this instalment with the transmission system and the propellers for a solid, scale, working model**

and was retained for many years by the Wright biplanes—a sure proof that it was satisfactory. It must be remembered that a breakage of one of the chains, or an accidental unshipping of the chain in flight,

would have slewed the aeroplane round, and would have meant instant calamity, as the 'plane would have been unable to regain its stability. Especially was this so owing to the fact that the com-

mon altitude of flight was only 100 to 200 feet above the ground. Flying in those days was chiefly a matter of soaring over the house- and tree-tops, and the heads of the spectators.

A very good idea of the transmission arrangement and the propeller mountings may be gathered from the photograph, which shows the rear of the model biplane, while Fig. 41 gives the necessary constructional details. The whole structure is made from 14 S.W.G. brass tubing. As a start, the propeller brackets, as shown in Fig. 42, should be constructed. Taking a piece of tubing, cut it to the length of (A), shown as 3 in. in the diagram. It will be as well to check that this measurement is correct for



The transmission system and propellers of the model "Wright" biplane.

your replica, as the tubes have to be a wedge fit between the rear spars of the wings, as may be noticed in the photograph. To the side of this tube, solder the bearing tube (B); then add the two tubes (C) (C). It will be seen that these are soldered to the side of the upright (A), but are chamfered off and soldered flush with the outer end of the tube (B). Small feet, cut from a piece of tin, are then soldered to the ends of the tube (A), in the manner shown in the small, encircled drawing at the bottom of Fig. 41.

To make the chain guards, it will be as well to start off by making a full-sized drawing of the arrangement. Taking the left-hand guard first, cut two lengths of tubing each  $4 \frac{11}{16}$  in. long, and solder one across the other in the manner indicated. To ensure accuracy, it will be as well to lightly bind them together with fine wire at the juncture of the cross, and adjust them upon your drawing before soldering. It will now be necessary to slightly bend these

assembly between the spars of the wings. To do this it will be necessary to thread the guard tubes behind the interplane struts. Now lightly bind the tubes to the support (S), as shown, and secure with a touch of solder. You will, of course, ensure that the inner ends of the guards line up correctly with the engine gear.

The right-hand guard assembly is easier to make than its fellow; it consists, primarily, of two 2-in lengths of tubing, joined together with two shorter lengths soldered flush with them. Do this construction upon the drawing, to ensure accuracy. In this case also, the tube (P) is soldered to the side of the short tube, but flush with the upright (A). With regard to the short leg upon which the inner end of the assembly stands, I have given no measurement for this, as it will be as well to offer the construction up to the job, and to ascertain the correct length of leg required to bring the ends of the guard tubes in correct relation

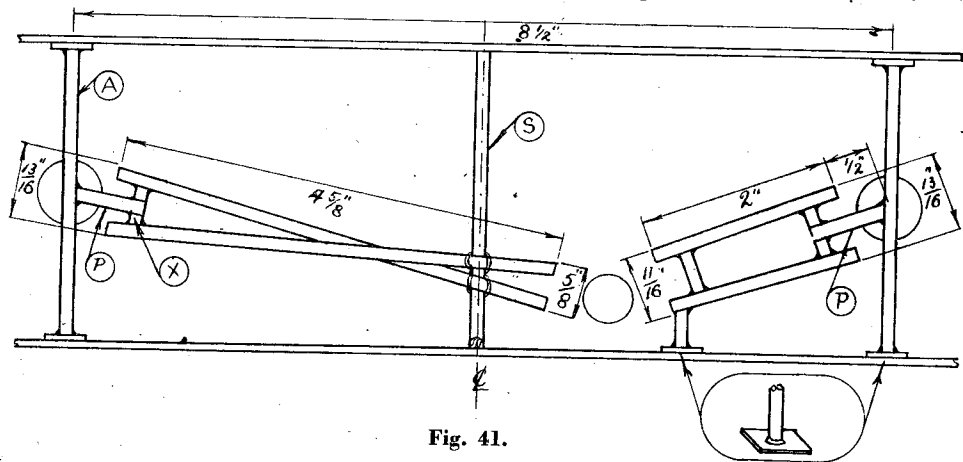


Fig. 41.

tubes, so that the ends are not offset, but will line up with the engine and propeller gear-wheels. Now sweat in the small tube (X). The strut-tube (P) is then soldered to the side of the tube (X), but is soldered flush with the upright (A). This will offset the ends of the guard tubes inwards, so that they will line up with the propeller gear-wheel.

The support (S) is cut from a piece of  $\frac{1}{4}$ -in. square hardwood, and is cemented between the wing spars, in the middle of the centre wing section; the bottom is, in fact, cemented upon the lower outrigger of the rudder, as may be seen in the picture. There is now no reason why this chain guard assembly should not be mounted within the wings. Flood the bases of the feet and the wing spars with cellulose cement, and push the propeller end of

to the engine gear. As in the previous case, fitting is by means of cellulose cement flooded on to the feet of the structure.

### Propellers

After much research, and correspondence with their European contemporaries, the Wright brothers evidently concluded that propeller design was far from satisfactory, so they set about designing their own, and seem to have evolved a remarkably good type. Their airscrews were of the "Chauviere" class, that is, the trailing edges of each blade formed a straight line through the axis of the airscrew. These propellers were geared down from the engine to run at a speed of 450 r.p.m., and for slow moving propellers a more efficient type has yet to be evolved. As a matter of fact, I often use the "Chauviere" propeller on

rubber-driven machines, as they are somewhat simpler to make than the symmetrical type, are efficient, and pretty to look at. Unlike most "Chauviere" airscrews, however, the Wright design was of the helical type; that is, the blades "twisted into each other" at the boss, without a very perceptible thickening up of this part. Contrary to a prevalent idea, the curved edge of a "Chauviere" propeller is the leading edge.

In Fig. 43 is shown the manner in which our model airscrews are constructed. The drawing (A) shows the face of a block of wood (almost any wood will suffice), 4 in. long by  $1\frac{1}{16}$  in. wide. Drawing (B) shows the side elevation of the block, and it will be seen that it is chamfered off at both tips, and slightly tapered inwards towards the boss. Diagram (C) shows this block with the propeller shape inscribed upon it. This done, the propeller blank should be cut out along the edges of the drawing. Now, on one side

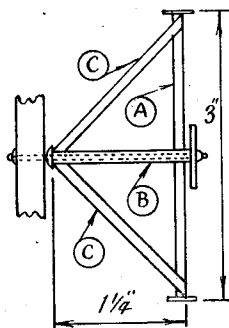


Fig. 42.

of the blank, draw a pencil line down both blades to correspond with the dotted lines in my drawing. This side of the blank should now be marked "Front." Carving may now proceed, and the lower drawing (D) shows how the surplus wood (shaded) is cut away. Care should be given to the blending of the blades into the boss of the airscrew, and the whole sanded smoothly into a neat twist. By cutting from the dotted line to the lower edge of the blades the pitch of the airscrew will develop automatically. One face of the propeller will be curved, and the other side flat; the side which we marked "Front" will be set towards the front of the aeroplane, and will be the curved side, as the airscrews are of the "pusher" type. Our drawing, Fig. 43, is of the airscrew in the left-hand side of the photograph.

It must be remembered that the airscrews revolved in opposite directions to each other, and that the right-hand one must, therefore, be carved in an opposite manner from that of the left. To do this, it will only be necessary to take a tracing of the drawing (C) in Fig. 43, reverse it, and trace through on to another piece of wood. In this way, the curved edge of the top blade will lie to the left of the centre line, and the curved edge of the lower blade to the right. Proceed to carve as before, and the airscrews will develop correctly.

The propellers are mounted upon spindles

of 14 G. steel wire, to one end of which is sweated the gear-wheels of  $\frac{1}{8}$ -in. in diameter. They are then pushed through the tube (B) (Fig. 42), a collet washer threaded on, then the propeller, and the whole secured by soldering a collet washer to the end of the shaft. It will be advisable to solder the

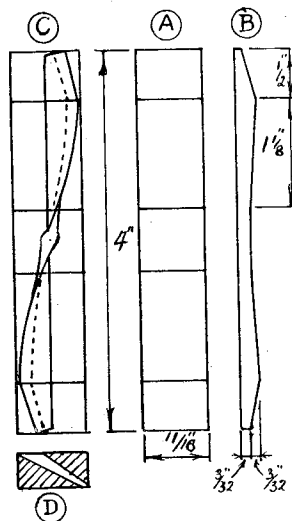


Fig. 43.

brass gear-wheel inconspicuously to the end of the tube (B) so that the gear-wheel will not revolve. The propeller, however, may be free to revolve independently upon the shaft. This should be done from a point of view of policy, as when you have finished the model, everyone to whom you show it *will revolve the propellers*. As the gear-wheels will be fitted with a light "chain" (now to be described) which will not run through the guards, your model will suffer many annoying breakages on a very "fiddling" part, if you do not allow the propellers to turn independently.

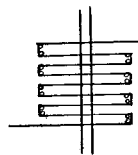


Fig. 44.

Those of you that have tried will know that one of the most puzzling things to imitate in model work is chain of the size which we require. I tried several plans before hitting upon the one about to be described. Briefly, the system consists of stretching two lengths of wire upon a board, inserting pins at intervals along the sides, and winding wire from one pin to the other across the two stretched wires. The wires are then soldered, and the surplus cut off.

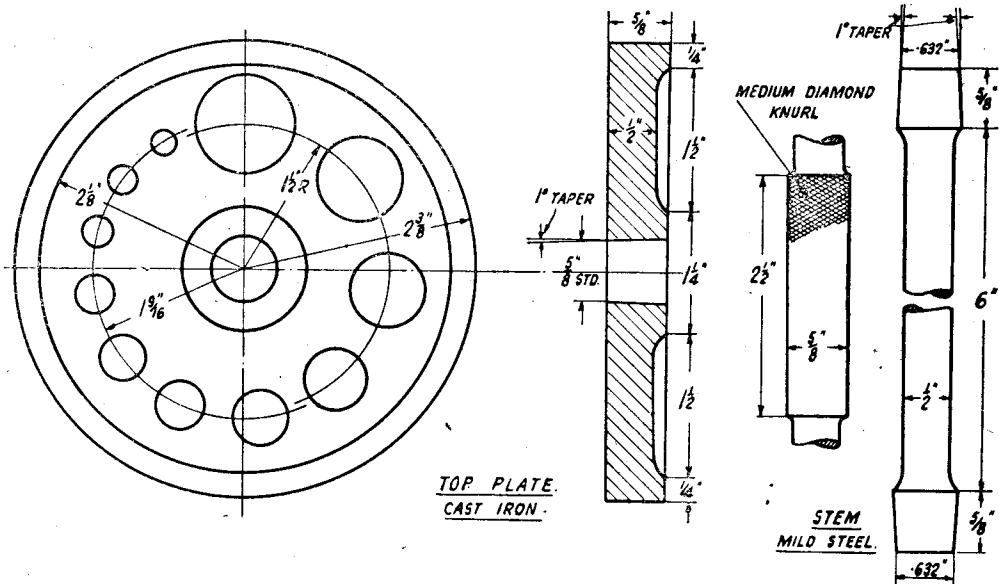
To commence, we must find the pitch of our gear-wheels. This may be easily done by running a gear-wheel along a piece of paper, and exerting enough pressure for the

(Continued on next page)

## A Set-block Stand

THIS useful tool was made entirely from scrap picked up at the local scrap dump. The two plates were made from gear wheels, one steel and one cast-iron. The cast-iron one was used for the top plate and after turning, and the taper bored, the holes were

flat. The bottom plate is identically the same as the top plate, except for the holes, and the taper, which is bored in the opposite way. The stem is made from any steel, convenient to the maker. Care must be taken over the tapers, to see that they are not



drilled and bored out. The holes shown in drawing are clearance holes for 1 in., 7/8 in., 3/4 in., 5/8 in., 9/16 in., 1/2 in., 7/16 in., 3/8 in., 11/32 in., 5/16 in., and 1/4 in. It is immaterial what holes are put in the top plate, those shown I have found are the most serviceable. When all the machining was finished, it was surface-ground; as this is out of the scope of most model engineers, it could be scraped up to a surface plate, as it must be perfectly

made too small, otherwise the stem will protrude through the plates, causing the stand to wobble, and causing obstruction on the top plate. This stand is very useful in conjunction with a small surface gauge, or set-blocks for marking-out positions of keyways, holes, etc., in shafts. It is also useful in marking-out crank and cam shafts. When not in use, the stand can be dismantled and put away from—rust.—F. E. COLES.

## Model Aeronautics

(Continued from previous page)

teeth to indent the paper. This will give us the spaces between the crossed wires. We may now insert pins, as indicated by the small circles in Fig. 44, to correspond with the indentations. Now stretch the two long wires between the pins and wind another piece of wire from one pin to the other, as shown. Florist's wire may be used, or, failing this, a strand of copper wire from some electric light flex. Use thin wire, because when you have flooded the assembly with solder a thick appearance will be obtained. After soldering, remove the wires from the board, and trim off all the loops of

wire which lie outside the two long wires, and clean the job up along the edges with a small file. Any of the "links" which have become filled with solder should also be cleaned out. This system presents us with quite a respectable looking length of cycle chain.

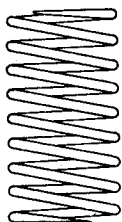
Naturally, very little strain can be imposed upon this imitation chain, and it is for this reason that I advise soldering the gear-wheels solid with the bearing tubes. Also, by doing this, only short lengths of chain need be made. In fact, just enough is required to encircle the gear-wheels and enter the openings in the guard tubes, where they may be secured with a small spot of solder.

(To be continued)

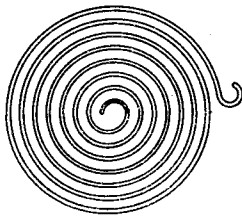
## Letters

### A Point in English

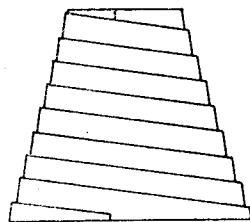
DEAR SIR,—*Re* your comment in THE MODEL ENGINEER for July 2nd of the meaning of the words helical, spiral and volute. As applied, for instance, to springs, the sketches explain where the difference is, which I am sure the motoring journals would confirm. As a matter of interest, I felt I could not let this pass without a comment, although most people in general engineering are rather hazy as to the definitions.



HELICAL



SPIRAL



VOLUTE

Perhaps you can find time to go a little further into this, as I feel sure the above is correct.

Yours faithfully,  
F. K. BARON.

Coventry.

DEAR SIR,—I notice that in your "Smoke Rings" of July 2nd one of your correspondents makes the surprising statement that "helix, spiral, and volute all mean the same." Far from it. Each is distinct in its meaning and application.

#### "Helix"

A "helix" is a curve in three dimensions; that is to say, it is not situated in one plane. It is the *locus* of a point which moves uniformly round and along the circumferential surface of a cylinder, each successive revolution being the same distance from the preceding one. In a sharp V-screw thread, for example, the line forming the top of the thread is a helix.

On the other hand, a "spiral" and a "volute" exist in one plane only.

#### "Spiral"

A "spiral" is the *locus* of a point moving so that its radius vector is proportional to its vectorial angle. Thus, the "pitch" (as we may term it) of a spiral is constant. A watch-spring is the most familiar example of the spiral.

#### "Volute"

A "volute" is constructed after a similar

manner, with the difference that while the vectorial angles are in *arithmetical* progression, the radius vectors increase in *geometrical* progression. The pitch of a "volute," therefore, increases uniformly, and, ultimately, with an infinite radius vector, the "curve" becomes a straight line. The volute is also known as a "logarithmic spiral." Examples of the volute are to be found in the casings of some turbines and centrifugal pumps.

I myself do not think that engineering nomenclature can be simplified to any great extent, as it is a vocabulary tending to be

precise in itself. This will explain why a person possessing the true engineering spirit, finding himself momentarily at a loss for a particular term or expression, invariably reaches for pencil and paper to illustrate his point, or being denied the means of graphic representation, generally relapses into a state of inarticulation.

Yours truly,  
ALFRED G. JORDAN.

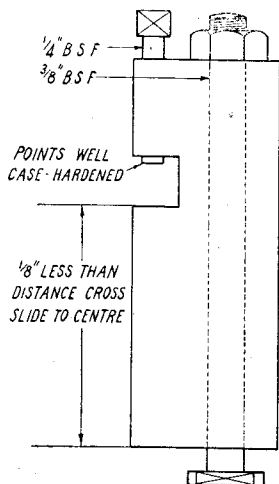
Redhill.

[The uncertainty in the employment of technical terms is well illustrated by the two letters above. One correspondent says a "volute" exists in one plane only, while the other illustrates a volute as being a spiral extended in a vertical direction. If a "spiral" exists in one plane only, how can we justify the use of the word in connection with a "spiral staircase"? Our original correspondent who raised this matter says, "Traders' misuse of terms settles nothing." He then quotes the "Concise Oxford Dictionary," which gives the following definitions:—*HELIX*—Spiral (like corkscrew, or in one plane, like watch-spring). *SPIRAL*—Coiled; winding about and constantly receding from a centre, whether remaining in same plane like a watch-spring or rising in a cone; winding continually and advancing as if along a cylinder, like thread of screw. *VOLUTE*—Spiral scroll, characteristic of Ionic, Corinthian, and Composite capitals.

There's a pretty tangle of definitions; what authority are we to accept?—ED., "M.E."]

### Parting-off

DEAR SIR,—During a discussion with a friend of mine a few weeks ago, the amateur turner's bugbear—parting-off—came under review. As he was sorely troubled by chattering whenever he attempted this operation, I advised him to follow capstan practice, and make a separate toolpost to carry his parting-tool upside down at the back of his cross-slide.



This expedient has proved so successful in his cheap  $3\frac{1}{2}$ -in. lathe that he is now able to part off  $\frac{1}{2}$ -in. dia. steel at about 500 r.p.m. entirely without chatter, using a HSS tool  $\frac{1}{8}$ -in. wide, running dry.

As the idea may be of value to others, I give herewith a sketch of the toolpost as fitted, and hope that any who are bothered by similar troubles will try it.

Yours faithfully,  
"HELM."

Liverpool.

### That T-square Holder

DEAR SIR,—One must accept Mr. Bradley's statement in *THE MODEL ENGINEER*, July 30th, that he has used the holder for the T-square for many years and found it most satisfactory.

As drawn, however, it would appear to function only on a small drawing; on a large drawing, where the T-square would approach the top and bottom of the board, the rollers would overrun the corners and add one more trial to the life of a draughtsman.

From time to time, such gadgets crop up, such as the magnet and steel edge, the friction roller ideas, etc., and most experienced draughtsmen have tried and discarded them all, and reverted to the simple expedient of a slight lateral pressure on the blade from the left hand.

Yours faithfully,  
EDWARD ADAMS.

Gatley.

## Clubs

### The Society of Model and Experimental Engineers

The Workshop at 20, Nassau Street, London, W.1, will open during the summer on Tuesdays and Thursdays at 7 p.m., and on Saturdays at 5 p.m., and meetings will be resumed in September.

Secretary, H. V. STEELE, 14, Ross Road, London, S.E.25.

### The West Midlands Model Engineering Society (Wolverhampton Branch)

It was decided at the last meeting of the above Society to start again in earnest on Wednesday, September 23rd, at our headquarters, the "Red Lion" Hotel, Snow Hill.

Hon. Sec., F. J. WEDGE, 13, Holly Grove, Penn Fields, Wolverhampton.

### Men of Maudslays'

On Friday, August 21st, members and their friends, on the invitation of their colleague, Mr. E. G. Izod, are to visit his extensive works at Weybridge.

Hon. Sec., WALTER T. DUNN, 56, Lanercost Road, Tulse Hill, London, S.W.2.

### Leeds Model Railway and Engineering Society

The above society have just had a very successful week on the sports ground of the English Electric Company. Over 3,000 persons had rides on the 80 ft. track, from two-year-olds to a lady of 91 years. Mr. C. E. Taylor, of Ardsley, ran his Pacific type loco. Mr. W. D. Hollings, of Birkenshaw, ran his "Miss-Ten-to-Eight," ably assisted by Mr. Bower of the Bradford Society. All the three locos. were constructed by the members named above. During August, on Saturday afternoons, locos. will be run in Roundhay Park. On August 30th, the subject of the meeting will be "Latent Talent"; on Saturday, September 19th, Mr. W. D. Hollings will give a talk on Model Boiler Making; this meeting will commence at 2.45 p.m.

Meeting place, F. Cook, Kidacre Street, Leeds.

Hon. Sec., H. E. STAINTHORPE, 151, Ring Road, Farnley, Leeds.

## NOTICES.

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

**Readers desiring to see the Editor personally can only do so by making an appointment in advance.**

All correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co Ltd., Cordwallis Works, Cordwallis Road, Maidenhead, Berks.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," Cordwallis Works, Cordwallis Road, Maidenhead, Berks.